HILGARDIA

A Journal of Agricultural Science

PUBLISHED BY THE

California Agricultural Experiment Station

VOLUME I

~~MAY~~, 1925 ~~TO JUNE~~, 1926

With 11 Plates and 143 Text Figures

UNIVERSITY OF CALIFORNIA PRINTING OFFICE
BERKELEY, CALIFORNIA
1926

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HILGARDIA

EXPLANATORY NOTE

With the completion of number twenty of the *Technical Papers* of this institution, the publication of which was commenced in January, 1923, this title has been abandoned and in the future the general type of articles formerly issued in the *Technical Papers* will be published under the title HILGARDIA. The numbers will be paged consecutively and as a volume of reasonable length is completed, a title page, table of contents, and general index will be prepared for each volume.

The chief reason for this change is the cumbersome title of the technical series, it being necessary to quote in full or by abbreviation of the major words the full title, which originally was: "University of California Publications. The Agricultural Experiment Station of the College of Agriculture, Technical Paper No. —." Due to policies adopted by the University Press it became necessary to change this title and the last few numbers were issued under the equally cumbersome title: "University of California, College of Agriculture, Agricultural Experiment Station, Berkeley, California, Technical Paper No. —." The advantages of a title consisting of a single word are manifest.

The title HILGARDIA has been selected to commemorate the services of Doctor Eugene Woldemar Hilgard (1833–1916), who organized the Agricultural Department of the University of California, and who founded the Agricultural Experiment Station in 1875.

President Benjamin Ide Wheeler at the Memorial Services held in honor of Doctor Hilgard, January 30, 1916, stated regarding his services:*

"Eugene Woldemar Hilgard has kept the faith. He has lived among his fellow men in active respect for the principles of order and authority. He has built his life into one of the most institutional forms of human society. He has been a

* Addresses at memorial services in honor of Dr. E. W. Hilgard, University of California, January 30, 1916. Univ. Calif. Chronicle 18:159–190. 1916. Reprinted by the University of California, Agricultural Experiment Station, under the title: In Memoriam, Eugene Woldemar Hilgard, 1–50. 1916.

gentleman. He has been true to the best methods and standards of the science in whose fields he has toiled. He has been loyal to the best traditions and standards of academic life."

Doctor E. W. Allen,* Chief of the Office of Experiment Stations, United States Department of Agriculture, in speaking of Doctor Hilgard's work states:

"The death of Dr. E. W. Hilgard, of California, closes a notable career of service to agriculture, both in length and in accomplishment. It marks the passing of the last of the earlier group of pioneers in agricultural education and research. The work he did dealt with the very fundamentals of agricultural advancement, at a period when men saw the needs less clearly and few were qualified to carry the work forward. Gauged by the time and opportunity, it will remain a great work. Who shall attempt to measure the result of it, or the influence of the high standards he set?"

It seems fitting and appropriate that the name HILGARDIA should be selected as a title of a serial publication of the California Agricultural Experiment Station in which is to be presented the results obtained by members of the staff from painstaking fundamental research on problems related to agriculture. This was the type of agricultural research for which Doctor Hilgard stood. Prominent biologists and patrons of science have had scientific periodicals named in their honor in such title as Addisonia, Bonplandia, Broteria, Candollea, Cassinia, Grevillea, Linnaea, Hedwigia, Malpighia, Muhlenbergia, Teysmannia, Torreya, Treubia, and Webbia. No valid reason exists why such an honor should not be extended to an agriculturist noted for his fundamental work, although the selection of such a title is an innovation in Agricultural Experiment Station literature. It is hoped that the articles that will appear in HILGARDIA, which will be of the same general type as those formerly issued in the series known as *Technical Papers*, will measure up to the high standards Doctor Hilgard set.

E. D. MERRILL,
Dean, College of Agriculture, and
Director of the Agricultural Experiment Station,
Berkeley, California.

April 1, 1925.

* Editorial in Experiment Station Record 34:301. 1916. In Memoriam, Eugene Woldemar Hilgard, 35. 1916.

HILGARDIA

A JOURNAL OF AGRICULTURAL SCIENCE

PUBLISHED BY THE

CALIFORNIA AGRICULTURAL EXPERIMENT STATION

VOL. 1 MAY, 1925 NO. 1

FRUIT-BUD DIFFERENTIATION IN DECIDUOUS FRUITS

BY

WARREN P. TUFTS AND E. B. MORROW

Fruit-bud formation, upon which fruit production is dependent, is undoubtedly influenced by such orchard practices as pruning, irrigation, and cultivation. For a successful study of the influence of these various practices upon fruit-bud formation, therefore, an intimate knowledge of the time of differentiation must be available. This paper is the report of studies which have been made under different California conditions over a period of nine years.

TIME OF FRUIT-BUD DIFFERENTIATION

It had been known in a general way that the flowers producing fruit in any year were formed some time during the preceding growing season, but it remained for Goff[6] to recognize definitely the initial stages of flower-bud formation in deciduous orchard fruits. He determined by morphological studies the time when differentiation into flower-buds first occurs and traced the successive stages of development until the unfolding of the blossoms in the spring.

Differences amounting to several days or weeks have been found to occur in the date of the initiation of fruit-bud formation with regard to both climatic influences, and to varieties and types of fruit.

Goff,[6] in a comparison of apple varieties, found a variation of as much as five weeks in the time of flower-bud formation.

Kramer[10] worked with several varieties each of the apple, pear, and cherry and found marked varietal differences, especially in the apple and pear. Little or no variation occurred in the cherry varieties studied. Kramer's work was conducted at Oppenheim, Germany.

Bradford,[1] working in Oregon, found that some varieties differed both in the date of differentiation and in subsequent stages of summer and fall development. Rather wide differences, depending upon the position of buds on the tree, were found to occur in the time of fruit-bud inception. In the Yellow Newtown, buds borne on spurs that had previously fruited, differentiated fully a month ahead of those borne terminally on one-year wood.

Magness[12] found that the initial stages in axillary buds of the apple occurred about one month later than in spur-buds on the same tree. He concluded that the difference between spur-buds and axillary buds seemed to be in degree of development and not in method.

Walker,[15] working under the direction of the senior author of this paper, found that, in 1915, apricot spur-buds differentiated about twenty to twenty-four days earlier than buds on shoots which were largely vegetative in character. During the summer of 1916, however, the difference in the time of differentiation was only from six to eight days.

Wiggans,[16] working also in California, determined the time of differentiation of the Bartlett pear and Royal apricot fruit-buds under the influence of three different sets of conditions, as follows:

1. Regional differences—a comparison of:
   a. Coastal valleys—mild equable climate; average rainfall, thirty inches; elevation, a little above sea level.
   b. Interior valleys—hot dry summers of low humidity; somewhat colder in winter than coastal valleys; average rainfall, about sixteen inches; elevation, a little above sea level.
   c. Foothills—mild climate; summer temperature about the same as coastal valleys; winter temperature somewhat colder than interior valleys; rainfall, about forty inches; elevation, 3000 feet.
2. Heavy vs. light pruning.
3. Irrigation vs. no irrigation.

Wiggans' results are presented in a graphic way in plates 1 and 2; his conclusions from the one season's work were as follows:

"1. Pear fruit-buds begin to differentiate at approximately the same date under coastal valley, interior valley, and foothill conditions.

"2. Apricot fruit-buds begin to differentiate at approximately the same date under coastal valley, interior valley, and foothill conditions.

"3. The high altitude of the foothills seems to have a retarding influence on fruit-bud development until the middle of September, when development becomes quite rapid.

"4. The humid coastal influence apparently stimulates rapid development of pear buds after differentiation. This is not the case with apricots until October, when development becomes extremely rapid and the buds go into the winter at a more advanced stage than is found under either interior valley or foothill conditions.

"5. The dry hot interior valley appears to induce a steady, uniform development of both pear and apricot fruit-buds; however, these have not reached the advanced stage of development by early winter that buds from the coastal valley and foothills have attained.

"6. The inception of fruit-bud differentiation seemingly is not influenced to any extent by either heavy or light dormant pruning. Light pruning perhaps tends to induce a slightly more rapid development for six to eight weeks after fruit-bud differentiation of the pear.

"7. Irrigation shows a tendency to retard fruit-bud differentiation and development.

"8. Environmental conditions during the winter, as found in the principal fruit growing districts of California, apparently do not exert a checking influence upon fruit-bud development of the pear and apricot."

Plates 1 and 2 present the above facts in graphic form.

Methods Used in this Investigation

Collection and Preservation of Material.—For the sake of brevity, no attempt is made at this time to describe the collection of materials which was made each season from 1915 to 1923, inclusive, except to say that with minor variations, these collections were identical with those which are here recorded for the 1923 season.

During 1923, all the material studied was collected on the University Farm at Davis, California. Probably various differences in soil, climate, and cultural treatments bring about minor differences in the time of differentiation; however, the work done by Wiggans tends to show that, at least for California and for the varieties studied, the results obtained from materials collected at the University Farm can be taken as generally applicable to the leading deciduous fruit sections of the state.

Material for study was secured at intervals of approximately ten days from May 18, up to the middle of August, 1923. From then until early November, collections were made every two weeks and subsequently at somewhat wider intervals until December 22. Collections were made from the following fruits and varieties:

Fruit	*Species*	*Variety*
Almond	*Prunus amygdalus*	Nonpareil
Apple	*Pyrus malus*	Gravenstein
Cherry (sour)	*Prunus cerasus*	Early Richmond
Cherry (sweet)	*Prunus avium*	Napoleon (Royal Ann)
Peach	*Prunus persica*	Elberta
Pear	*Pyrus communis*	Bartlett
Plum (European)	*Prunus domestica*	French (prune)
Plum (Japanese)	*Prunus salicina* × *Prunus simonii*	Wickson

Only spur-buds were collected from the almond, apple, apricot, cherry, pear, and plum, while from the peach, buds were collected from the current season's shoots only. At each collection approximately forty buds, well distributed throughout the tree, were taken and immediately put into the formalin-alcohol killing and fixing solution* in which they were preserved until sectioning could be accomplished.

Sectioning.—With the apricot, cherry, plum, and peach, the paraffin method of embedding as outlined by Chamberlain[2] was found reasonably satisfactory as a means of preparing the buds for sectioning. With the apple and pear, however, the paraffin method proved unsatisfactory because of the extremely hairy nature of the material. Even with the careful trimming off of the bud scales or other woody portions and the removal of a large number of hairs under the dissecting microscope, infiltration was difficult and the sections broke on the microtome blade.

Much time was spent in an effort to find a satisfactory method of sectioning this refractory material. Chloroform was tried as a clearing agent, but buds cleared in chloroform sectioned little better than those cleared in xylol. Buds were also soaked in hydrofluoric acid for a period of ten days to two weeks before being embedded in paraffin, but this too gave only indifferent results.

* Killing and fixing solution: Alcohol, 50 per cent........................94 cc.
Formalin, 40 per cent........................ 6 cc.

A considerable amount of effort was spent in trying to adapt a combination of the paraffin and celloidin methods to the material in hand. The first method tried was that reported by Kornhauser,[9] but the infiltration process is long, and the results secured in sectioning were not satisfactory. An attempt was made to shorten the celloidin infiltration by using Gilson's[5] "Rapid Process" method, but few successful sections were thus obtained. An abridgment of the Kornhauser method by de Zeeuw[3] of Michigan gave reasonably satisfactory results. By this method the material was infiltrated in medium celloidin and then dropped directly into chloroform. In preparation for the paraffin infiltration and embedding, Apathay's oil mixture was omitted and chloroform was substituted for benzol.

De Zeeuw's method is short and convenient to use, and offers many of the advantages of the celloidin and paraffin methods with few of the disadvantages of either. He reports that with ordinary fixatives the sections sometimes wash off the slides when the celloidin is removed; he recommends, therefore, Szomobathy's gelatin fixative wherever this difficulty is experienced. However, in the present investigation, no trouble of this kind arose while using an albumen-glycerine fixative, when the paraffin was dissolved in xylol and the celloidin in ethyl alcohol.

Staining.—A combination stain of safranin and Delafield's haemotoxylin gave the most satisfactory results. The sections were over-stained in safranin and de-stained in acid alcohol; then over-stained in haemotoxylin and reduced by placing in water to which had been added a few drops of concentrated hydrochloric acid.

Presentation of Results

Goff[6] considered that slight irregularities in the growing point or crown of the bud were the first evidences that differentiation had taken place. He found that in the individual flower-bud, the calyx was first to be formed, and concluded that "in the normal order of development the corolla originates next after the calyx, and is followed in turn by the stamens and pistil."

Drinkard[4] also considered that corrugations on the crown of the bud were the first morphological evidences that a differentiation into flower-buds had taken place.

Kraus,[11] in a study of the gross morphology of the apple, has the following to say with regard to the first indications of a change into a flower-bud: "From a study of many sections and dissections, it is found that the first observable indication of the flower is the more or less thickening of the axis. Minute bracts, in the axils of which are formed blunt protuberances, arise from it in a very close spiral. The tip of the axis never loses its identity, but on the contrary enlarges considerably and always develops slightly in advance of the protuberances immediately below it. Later, these protuberances develop into definite individual flowers."

Bradford,[1] in writing of the apple, says that "the first evidence of fruit-bud formation lies in the rapid elevation of the crown into a narrow conical form, rounded at the apex, with the fibro-vascular connections and pith areas advancing concurrently. In the axils of the young leaves, already noted in connection with the differentiated bud, appear other protuberances which soon become blunt at the tip, while at the same time other leaf protuberances appear in their axils. The apical protuberance is differentiated last, but when it does take shape it is already larger than those previously laid down, apparently appropriating a larger mass of tissue in its formation."

In this investigation the authors have considered the definite broadening and thickening of the floral axis as evidence of the first differentiation of the floral parts. The formation of slight proturberances which eventually become calyx, corolla, stamens, and pistil follows almost immediately, varying somewhat in detail, of course, with the different species. The detailed comments on the specific fruits apply particularly to the 1923 season unless otherwise mentioned.

Almond.—The Nonpareil almond showed no signs of differentiation until September 1 (pl. 3, fig. 3). Several buds from this collection showed elongated crowns, flattened on top, indicating that differentiation had already occurred. In the case of buds from the collection made on September 15 the crown had thickened considerably, and the sepal primordia had begun to push up from the sides. Salinger,[13] working in California during the 1915 season, found that differentiation had occurred in the I.X.L. variety of almond on August 18.

Apple.—In the Gravenstein apple some of the buds from the collection made on June 11 had already begun to develop into flower-buds (pl. 4, fig. 1). By June 20, the apical flower had enlarged considerably and was showing prominent sepal primordia, and the adjacent flowers were clearly visible. Growth was rapid during the next few days and the petal primordia had appeared on July 11. Buds collected on August 17 showed stamen primordia, and by October 13 the early stages of pistil formation were plainly visible. Later growth was apparently somewhat slower, few changes occurring from November 10 to December 22.

Apricot.—The Royal apricot showed first signs of differentiation on August 10 (pl. 5, fig. 1). At this time the axis of the crown was considerably thickened, and the sepal primordia were beginning to arise from the sides. Walker[15] observed the initial stage on August 4, 1915, and August 10, 1916, and Wiggans[16] on August 10, 1922. The gradual development of the flower-bud is shown (pl. 5, figs. 2–8).

Cherry.—The first collection of Early Richmond cherry (*Prunus cerasus*) was made on July 12. At this time the earlier stages of the individual flower-buds had appeared in the form of prominent protuberances (pl. 6, fig. 1). By August 10, both sepal and petal primordia were plainly visible, and buds from the collection of September 1 showed the earlier stages of stamen and pistil formation. All flower parts had very nearly assumed their final form by September 29, and the ovarian cavity had appeared on October 13. Growth was relatively slow from early November until December 22.

In the Napoleon (Royal Ann) cherry (*Prunus avium*), the first clear evidences of differentiation appeared on July 3 (pl. 7, fig. 1). By July 30 the sepal protuberances were beginning to push up from the sides of the buds, and on August 17 both petal and stamen primordia had appeared, and the pistil was beginning to grow from the base of the flower-cup. All flower parts had assumed their final form by late September, little development occurring from this time until late in the dormant season.

Peach.—In the Elberta peach, differentiation had taken place by July 30 (pl. 8, fig. 2). On August 10 the sepal primordia were beginning to appear and by August 17 the earlier stages of petal formation were clearly visible.

Pear (pl. 9).—In collections from the Bartlett pear made on June 21, some of the buds showed the earlier stages of fruit-bud formation. By July 3 the axial flower-buds had appeared. Growth was gradual from this time until the latter part of November; few gross changes took place from November 30 until early spring. The results here reported complete three seasons observations in California of fruit-buds of the Bartlett pear. In 1915 Henderson[8] found first evidences of differentiation on July 3, and Wiggans[16] working during the 1922 season, found that differentiation had occurred on July 4. Although some of the buds from the collection of June 21, 1923, showed evidences of flower-bud formation, it is quite probable that the percentage of buds differentiated at this time is very small, and fruit-bud differentiation in the Bartlett pear under California conditions may be said to begin during early July.

Plum (pl. 10).—Buds from the French prune (*Prunus domestica*) collected on August 10 showed no signs of differentiation, but those collected on August 17 showed individual flower-buds. Generally speaking, the stages of growth were somewhat variable on the same date. This may be partly accounted for by the fact that the tree from which the buds were collected was practically defoliated in August by a severe infestation of red spider. It is of interest to note that Hartwell[7] found the first observable stages of differentiation in the French prune to occur six weeks earlier during 1920 than was the case in 1923.

Bud specimens taken on August 10 (pl. 11, fig. 1) from the Wickson plum (*Prunus salicina* × *Prunus simonii*), showed the bud scales still arising from the sides of the crown; no evidences of differentiation were found. By September 1 the individual flower-buds had appeared and the sepal primordia were pushing up from the sides of the bud. In the collection of October 13, the earlier stages of petal, stamen, and pistil formation were visible, and by December 22 all flower parts had assumed final form. Trunk[14] found that the Wickson plum showed first evidences of differentiation on July 31 during the 1915 season.

Table 1 gives in condensed form the findings of various investigators, including those reported here, as to initiation of flower-bud formation in deciduous fruits.

TABLE 1

Fruit	Variety	Differentiation first noted	Locality	Investigator
Almond	I. X. L.	August 18, 1915	California	Salinger
	Nonpareil	September 9, 1923	California	Tufts and Morrow
Apple	Hoadley	June 30, 1899	Wisconsin	Goff
	Oldenburg	June 30, 1909	Virginia	Drinkard
	Yellow Newtown	Early July, 1912	Oregon	Bradford
	Gravenstein	June 11, 1923	California	Tufts and Morrow
Apricot	Royal	August 4, 1915	California	Walker
	Royal	August 10, 1916	California	Walker
	Royal	August 11, 1922	California	Wiggans
	Royal	August 10, 1923	California	Tufts and Morrow
Blackberry	Snyder	Late August, 1915	New York	MacDaniels
Cherry	King's Amarelle	July 11, 1899	Wisconsin	Goff
	King's Amarelle	July 5, 1900	Wisconsin	Goff
	Louis Phillippe	July 1, 1909	Virginia	Drinkard
	(No variety named)	Before end of July, 1922	Germany	Kramer
	Early Richmond	July 12, 1923	California	Tufts and Morrow
	Napoleon(Royal Ann)	July 3, 1923	California	Tufts and Morrow
Cranberry	(No variety named)	September 16, 1900	Wisconsin	Goff
Currant	Pomona	July 8, 1900	Wisconsin	Goff
	Black Victoria	August 3, 1900	Wisconsin	Goff
	Cherry Red	Early August, 1915	New York	MacDaniels
Filbert	(No variety named)	Catkins—June 10, 1894 Pistillate flowers— Early September	Germany	Albert
Gooseberry	Downing	August 30, 1900	Wisconsin	Goff
	Houghton	Early August, 1915	New York	MacDaniels
Grape	(No variety named)	Mid-June, 1898	Germany	Behrens
Peach	Bokhara	September 21, 1900	Wisconsin	Goff
	Luster	July 7, 1909	Virginia	Drinkard
	Deming's September	June 14, 1900	Georgia	Quaintance
	Elberta	June 30, 1923	California	Tufts and Morrow
Pear	Wilder Early	July 21, 1899	Wisconsin	Goff
	Wilder Early	September 6, 1900	Wisconsin	Goff
	Kieffer	July 15, 1909	Virginia	Drinkard
	Bartlett	July 3, 1915	California	Henderson
	Bartlett	July 4, 1922	California	Wiggans
	Bartlett	June 21, 1923	California	Tufts and Morrow
Plum	Rollingstone	July 8, 1899	Wisconsin	Goff
	Rollingstone	July 5, 1900	Wisconsin	Goff
	Whitaker (Wild Goose)	September 1, 1909	Virginia	Drinkard
	Japanese	July 14, 1909	Virginia	Drinkard
	Wickson	July 31, 1915	California	Trunk
	Wickson	Mid-August, 1923	California	Tufts and Morrow
Prune	French	June 29, 1920	California	Hartwell
	French	Mid-August, 1923	California	Tufts and Morrow
Raspberry	Cumberland (Black)	October 6, 1915	New York	MacDaniels
	Herbert (Red)	January 11, 1916	New York	MacDaniels
Strawberry	Clyde	September 20, 1900	Wisconsin	Goff

Summary

A study has been made, using approved laboratory methods, of the date of fruit-bud differentiation in some of the principal fruits of temperate climates produced in California. The approximate dates of differentiation are briefly summarized in the following table:

TABLE 2

Fruit	Variety	Date of Differentiation
Almond	Nonpareil	Late August—Early September
Apple	Gravenstein	Mid-June
Apricot	Royal	Early August
Cherry (Sour)	Early Richmond	Early July
Cherry (Sweet)	Napoleon (Royal Ann)	Late June—Early July
Peach	Elberta	Late July
Pear	Bartlett	Late June—Early July
Plum (European)	French	Late July—Early August
Plum (Japanese)	Wickson	Late July—Early August

The following conclusion seems justified:

The date of differentiation may vary somewhat in widely separated regions within any one species, although it seems that under most conditions in California little variation occurs.

Acknowledgments

The writers wish to express their appreciation to the following:

To the several advanced undergraduates and graduate students, mentioned specifically in the text, without whose aid in the collection, preparation, and study of a large amount of the material it would have been impossible to complete the work here reported.

To Miss Edna Russ for her untiring assistance in the preparation of the photographs used as illustrations.

To Drs. W. L. Howard, E. J. Kraus, and W. W. Robbins for suggestions and criticisms.

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EXPLANATION OF THE PLATES

PLATE 1

Outline drawings of longitudinal sections through Bartlett pear fruit-buds showing the average stages of development at different dates under various climatic environments, soil moistures, and pruning treatments. (From thesis by Wiggans.)

PLATE 2

Outline drawings of longitudinal sections through Royal apricot fruit-buds showing the average stages of development at different dates, under various climatic environments, soil moistures, and pruning treatments. (From thesis by Wiggans.)

PLATE 3

Photomicrographs of longitudinal sections through fruit-buds of the Nonpareil almond (× 40).

Fig. 1. July 30, 1923.
Fig. 2. August 17, 1923.
Fig. 3. September 1, 1923.
Fig. 4. September 15, 1923.

PLATE 4

Photomicrographs of longitudinal sections through fruit-buds of the Gravenstein apple (× 40).

Fig. 1. June 11, 1923.
Fig. 2. July 11, 1923.
Fig. 3. October 13, 1923.
Fig. 4. December 22, 1923.

PLATE 5

Photomicrographs of longitudinal sections through fruit-buds of the Royal apricot (× 40).

Fig. 1. August 10, 1923.
Fig. 2. September 1, 1923.
Fig. 3. October 5, 1915.
Fig. 4. October 30, 1922.

PLATE 5—(*Continued*)

Photomicrographs of longitudinal sections through fruit-buds of the Royal apricot (× 40).

Fig. 5. November 22, 1915.
Fig. 6. January 13, 1916.
Fig. 7. February 10, 1916.
Fig. 8. February 17, 1916.

PLATE 6

Photomicrographs of longitudinal sections through fruit-buds of the Early Richmond cherry (× 40).

Fig. 1. July 12, 1923.
Fig. 2. August 17, 1923.
Fig. 3. September 15, 1923.
Fig. 4. November 30, 1923.

PLATE 7

Photomicrographs of longitudinal sections through fruit-buds of the Napoleon cherry (× 40).

Fig. 1. July 3, 1923.
Fig. 2. July 30, 1923.
Fig. 3. August 17, 1923.
Fig. 4. November 20, 1923.

PLATE 8

Photomicrographs of longitudinal sections through fruit-buds of the Elberta peach (× 40).

Fig. 1. July 20, 1923.
Fig. 2. July 30, 1923.
Fig. 3. August 10, 1923.
Fig. 4. August 17, 1923.

PLATE 9

Photomicrographs of longitudinal sections through fruit-buds of the Bartlett pear (× 40).

Fig. 1. July 21, 1923.
Fig. 2. July 31, 1922.
Fig. 3. November 30, 1923.
Fig. 4. February 28, 1923.

PLATE 10

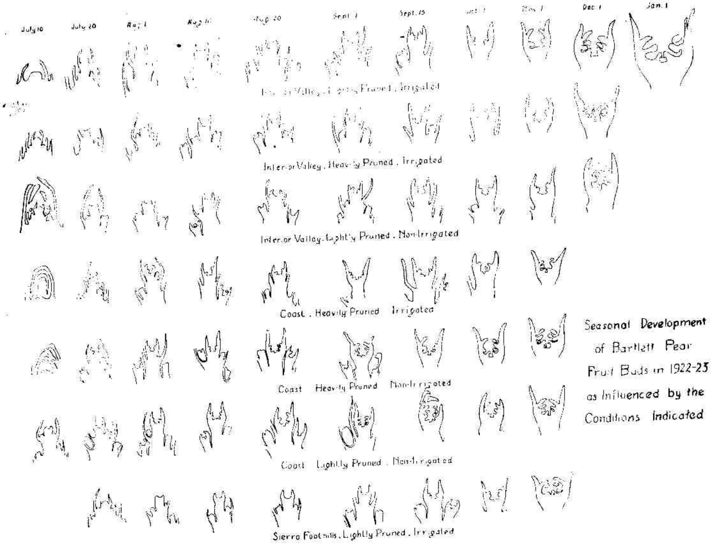
Photomicrographs of longitudinal sections through fruit-buds of the French prune (× 40).

Fig. 1. August 17, 1920.
Fig. 2. September 15, 1920.
Fig. 3. December 7, 1920.
Fig. 4. February 2, 1921.

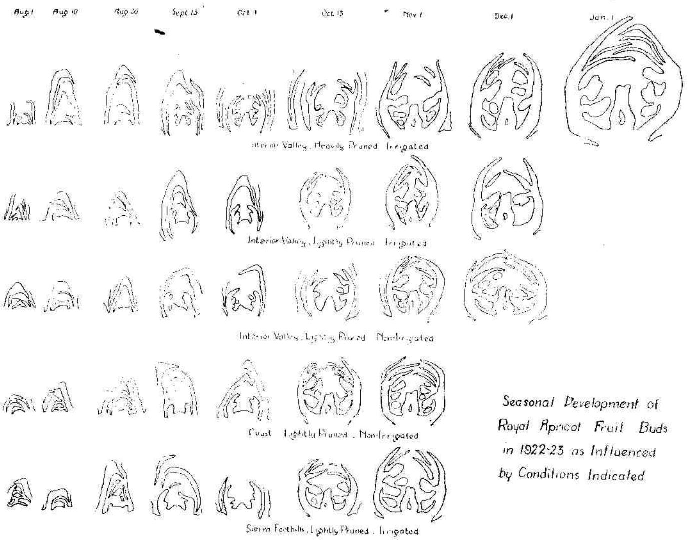
PLATE 11

Photomicrographs of longitudinal sections through fruit-buds of the Wickson plum (× 40).

Fig. 1. August 10, 1923.
Fig. 2. September 1, 1923.
Fig. 3. October 13, 1923.
Fig. 4. December 22, 1923.



Seasonal Development of Bartlett Pear Fruit Buds in 1922-23 as Influenced by the Conditions Indicated



Seasonal Development of Royal Apricot Fruit Buds in 1922-23 as Influenced by Conditions Indicated

NONPAREIL ALMOND

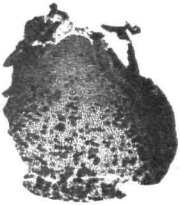


Fig. 1

Fig. 2

Fig. 3

Fig. 4

GRAVENSTEIN APPLE

Fig. 1

Fig. 2

Fig. 3

Fig. 4

ROYAL APRICOT

Fig. 1

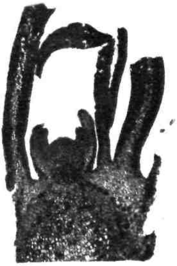


Fig. 2

Fig. 3

Fig. 4

ROYAL APRICOT

Fig. 5

Fig. 6

Fig. 7

Fig. 8

EARLY RICHMOND CHERRY

Fig. 1

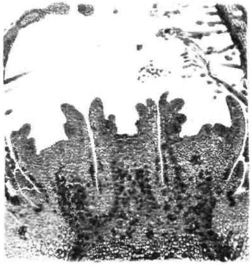


Fig. 2

Fig. 3

Fig. 4

NAPOLEON CHERRY

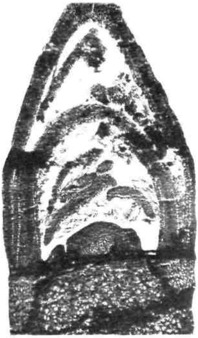


Fig. 1

Fig. 2

Fig. 3

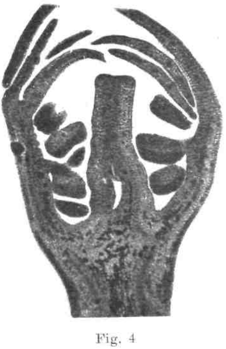


Fig. 4

ELBERTA PEACH

Fig. 1

Fig. 2

Fig. 3

Fig. 4

BARTLETT PEAR

Fig. 1

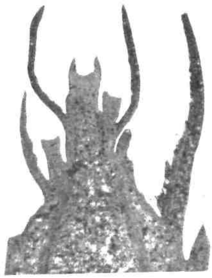


Fig. 2

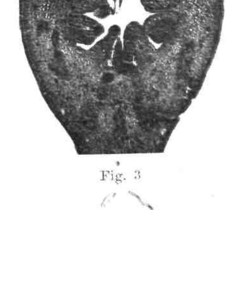


Fig. 3

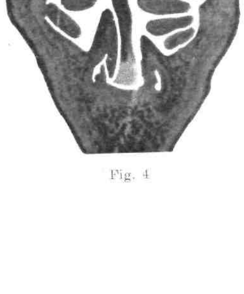


Fig. 4

FRENCH PRUNE

Fig. 1

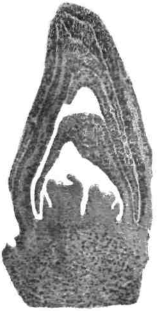


Fig. 2

Fig. 3

Fig. 4

WICKSON PLUM

Fig. 1

Fig. 2

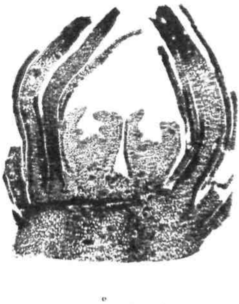


Fig. 3

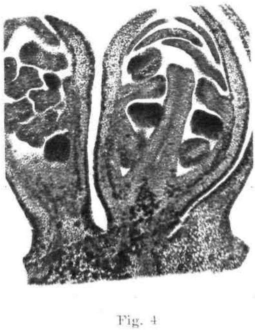


Fig. 4